What is claimed is:

1. A data packet traffic managing method of providing adaptive bandwidth management and scheduling to a variable length data packet switch/router system in a converged network environment that receives different types of data packet traffic flow having different specific customer-assigned service requirements such as definition of service, priority, delay, jitter and bandwidth characteristics, and for routing the data packet flow to a common communication link for simultaneous transmission flow along the common link, the method comprising, allocating different amounts or percentages of bandwidth to each type of data packet traffic in accordance with its respective customer-assigned service requirements; and scheduling the departure order of the different types of traffic flow from the router to the communication link based upon and adapted to said respective service requirements, and with preservation of the respective various traffic characteristics and priorities, whereby the switch/router provides differentiated services for the various data traffic types, while simultaneously substantially filling the total data packet flow capacity utilization of the link.

2. The method of claim 1 wherein the bandwidth allocating is balanced with the priority of the type of service and in a guaranteed way.

3. The method of claim 1 wherein the bandwidth allocating and the scheduling are effected independently of one another, thereby enabling the router to provide such differentiated services.

4. The method of claim 1 wherein the bandwidth allocating management also implements the full capacity dataflow utilization of the link without wasting bandwidth.

5. The method of claim 1 wherein the different data packet traffic is routed to corresponding egress queues, the bandwidth allocating selects the amounts of bandwidth assigned to each of the queues determining how much data should be released from each queue, and the scheduling, independently of the bandwidth allocating, selects the order or priority of data packet release from the queues to the common communication link.

6. The method of claim 5 wherein the presence of data in each queue is sensed and indicated to the traffic managing for enabling awareness as to the presence of data in the queue.

7. The method of claim 6 wherein, in accordance with such sensing and awareness, unused or "free" bandwidth allocated to but not used in a queue, is made available for use by another queue that has more data to send than its allocated bandwidth will permit.

8. The method of claim 7 wherein the unused bandwidth of the queues is managed in a "free" " bucket" to be available for allocation to other queues that can utilize the same, thereby to insure the full capacity utilization of the link and without wasting bandwidth.

9. The method of claim 8 wherein the making available of "free" bandwidth from one queue to another queue that can utilize the same, is effected without crediting or debiting any queue.

10. The method of claim 9 wherein each queue is provided with a base weight system and counter to enable users to control the percentage of "free" bandwidth distributed in the different queues, with the "free" bandwidth managing making assignment to a queue based upon such weights, the amount of data present in queue memory, and on the "free" bandwidth available.

11. The method of claim 5 wherein bandwidth utilization is performed by providing a first stage feedback control between packet data line cards and the sequencing, and a second stage feedback between the scheduling and the bandwidth-allocating, in order automatically to dynamically equalize the rate between the physical transmission link, the scheduling, and the bandwidth allocating.

12. The method of claim 5 wherein the traffic managing tracks the bandwidth based on the size of the data packet payload, scheduling data out from output FIFOs with a minimum over-speed, and, in response to feedback from the data output FIFOs that indicates the amount of data accumulation therein, enabling matching the scheduling rate of traffic managing to the output line rate, maintaining data accumulation at a proper level.

13. The method of claim 11 wherein the bandwidth allocating, the scheduling, and the "free" bandwidth management, are each controlled by separate programmable parameters, with inputs for adapting or setting in accordance with specific customer-allocated parameters that control the traffic transmitted on the link.

14. In a system for variable length data packet traffic flow, a configurable adaptive bandwidth management and scheduling apparatus for a data packet switch/router system in a converged network environment for receiving different types of data packet traffic flow, said apparatus having, in combination, means for receiving the different types of data packets with respective different specific customer-assigned service requirements such as definition of service, priority, delay, jitter and bandwidth characteristics, to be routed to a common communication link for simultaneous transmission flow therealong; bandwidth allocation means for allocating different amounts or percentages of bandwidth

to each type of data packet traffic in accordance with its respective customer-assigned service requirements; means for scheduling the departure order of the different types of traffic flow from the router to the communication link based upon and adapted to said respective service requirements; and means for preserving the respective various traffic characteristics and priorities for each different type of data packet traffic, whereby the switch/router provides differentiated services for the various data traffic types, while simultaneously substantially filling the total data packet flow capacity utilization of the link.

15. The apparatus of claim 14 wherein the bandwidth allocating means balances the priority needs of the type of service and in a guaranteed way.

16. The apparatus of claim 14 wherein the bandwidth allocating means and the scheduling means are operated independently of one another, thereby enabling the router to provide such differentiated services.

17. The apparatus of claim 14 wherein the bandwidth allocating means also implements the full capacity dataflow utilization of the link without wasting bandwidth.

18. The apparatus of claim 14 wherein the different data packet traffic is routed to corresponding egress queues and, the bandwidth allocating means selects the amounts of bandwidth assigned to each of the queues, determining how much data should be released from each queue, and the scheduling means, independently of the bandwidth allocating, selects the order or priority of data packet release from the queues to the common communication link.

19. The apparatus of claim 18 wherein means is provided for sensing the presence of data in each queue and indicating the same for enabling awareness as to the presence of data in the queue.

20. The apparatus of claim 19 wherein means is provided, operable in accordance with such sensing and awareness for making unused or "free" bandwidth allocated to but not used in a queue, available for use by another queue that has more data to send than its allocated bandwidth will permit.

21. The apparatus of claim 20 wherein means is provided for accommodating the unused bandwidth of the queues in a "free" "bucket" to be available for allocation to other queues that can utilize the same, thereby to insure the full capacity utilization of the link and without wasting bandwidth.

22. The apparatus of claim 21 wherein the making available of "free" bandwidth from one queue to another queue that can utilize the same, is effected without crediting or debiting any queue.

23. The apparatus of claim 22 wherein each queue is provided with a base weight system and counter to enable users to control the percentage of "free" bandwidth distributed in the different queues, with the "free" bandwidth allocation means making assignment to a queue based upon such weights, the amount of data present in queue memory, and on the "free" bandwidth available.

24. The apparatus of claim 18 wherein bandwidth utilization is performed by providing a first stage feedback control between packet data line cards and the sequencing means, and a second stage feedback between the scheduling and the

bandwidth-allocating means, in order automatically to equalize the rate between the physical transmission link, the scheduling, and the bandwidth allocating.

25. The apparatus of claim 18 wherein the traffic management tracks the bandwidth based on the size of the data packet payload, scheduling data out from output FIFOs with a minimum over-speed, and, in response to feedback from the data output FIFOs that indicates the amount of data accumulation therein, matching the scheduling rate of traffic managing to the output line rate, maintaining data accumulation at a proper level.

26. The apparatus of claim 24 wherein the bandwidth allocating, the scheduling, and the "free" bandwidth management means, are each controlled by separate programmable parameters, with inputs for adapting or setting in accordance with specific customer-allocated parameters that control the traffic transmitted on the link.

27. The method of claim 1 wherein said filing of the total data packet flow capacity is effected by scheduling the different data packet traffic to flow successively and alternately without holes in the transmission flow.

28. The apparatus of claim 14 wherein said filling of the total data packet flow capacity is effected by means for scheduling the different data packet traffic to flow successively and alternately without holes in the transmission flow.